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IMPROVEMENT OF THE FLOAT-PROCESS TECHNOLOGY

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The problems of production of float glass are discussed. The possibilities of shortening the duration of conversion from one type of glass to another on the same production lines, of improving the optical parameters of float glass etc. are demonstrated. The developed techniques make it possible to improved the quality of glass to increase the production volume and expand the product range.

The bulk of sheet glass in Russia, as everywhere in the world, is produced by the float method, which replaced the outmoded vertical-drawing technology and makes it possible to produce high-quality glass.

Owing to research carried out at the Saratov Institute of Glass, the technical upgrade of sheet glass production in Russia is nearly completed. This industry numbers several production lines of various capacities producing glass of different thickness.

The development and implementation of the float method in the industry could justifiably be called an engineering revolution. It has affected not only the building materials but the construction and architecture as well. The possibility of obtaining great quantities of high-quality sheet glass enabled the architects to view glass not only as glazing for window apertures but also as facing and structural materials for walls and roofs. Office buildings with continuous glazing of facades are becoming common now. Glass is successfully used as well in designing small structures: shopping pavilions, public transport waiting areas, etc. All this leads to substantial expansion in the range of sheet glass products. As a consequence, the float technology needs to be refined in order to meet the increasing requirements. New techniques and methods have to be developed to produce new kinds of glass.

The Saratov Institute of Glass has more than 30 years of experience in setting up production of glass over tin melt and continues research in the sphere of new technologies that make it possible to deliberately control the composition, properties, and quality of glass in the course of production and to expand the range of sheet glass products.

In this context an important problem arises of reducing the time needed to change over from one type or size of glass to another. To remain competitive in the market, manufacturers sometimes have to take urgent orders for a particular type of glass, which calls for a fast conversion of the production line to a new operating regime. Such transitions generate glass waste, which ought to be minimized.

It is established that the main transition stages are the rearrangement of technological equipment, adjustment of the temperature and velocity regimes, modification of the physicochemical conditions of the melt tank, and achieving the required quality of the glass band.

To shorten the duration of equipment rearrangement, measures are taken to standardize its layout and to equip a float tank with stationary technological equipment, which does not need to be shifted and is switched on when needed. These measures gradually reduce the need of machinery rearrangement to a reasonable minimum.

The modification of velocity and temperature regimes takes a certain time due to the inertia of the float process. Consequently, one of the methods for shortening the time of conversion at this stages implies a simultaneous adjustment of the specified parameters and a short-term intense effect on the temperature conditions of the float tank (for instance, temporary installation of a roof chiller in the head part of the melt tank melt converting from 3 – 4 mm glass to 8 – 12 mm glass).

The longest part of the transition is restoration of the physicochemical conditions in the melt tank. The trend in this area is to schedule the sequence of production of certain types of glass in the float tank. For instance, after producing decorative glasses, which involves an introduction of reactants decreasing the reducing potential of the gas medium, it is convenient to change over to production of glass on which no high requirements are imposed (for instance, shaped glass). Another method for shortening the time of conversions involving a modification of the physicochemical conditions in the melt tank is the introduction of catalysts accelerating the reduction processes

The Saratov Institute of Glass carries out active research intended to increase the reducing potential of the gas me-

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dium by modifying the physiochemical conditions of molding. The traditional techniques of controlling the gas regime of the melt tank by differential feed of hydrogen to various zones, a certain multiplicity of changing the protective atmosphere, and other measures are not always sufficient to prevent the formation of tin oxides or to reduce these oxides. As a rule, the low-temperature head part of the tank always contains oxides on the surface of melted tin, whose adhesion to the bottom surface of glass causes defects. Furthermore, expensive tin becomes wasted in this way. This is due to the fact that the reducing potential of hydrogen at a temperature below 700°C is virtually equal to zero (in the tail part of the melt tank the temperature is 700 – 600°C).

The use of the method developed by the Saratov Institute of Glass makes it possible to efficiently reduce tin oxides in the tail part of the tank by introducing small quantities of a reducing gas (carbon monoxide), which is able to reduce tin oxides starting with the temperature of 450°C, into the tail part of the tank. It is important to note that when the protective atmosphere is produced by high-temperature incomplete combustion of natural gas mixed with air (the method developed at the Saratov Institute of Glass), carbon monoxide is a by-product impurity and therefore no additional expense is needed to introduce it into the melt tank (RF patents Nos. 2178765 and 2181102).

The Institute is researching the possibilities of upgrading the slag chamber, its design, and the gas regime inside it. This research is important not only due to the fact that the slag chamber as an intermediate structural unit prevents contamination of the annealing furnace shafts by tin oxides and penetration of the ambient medium gases into the melt tank via the outlet opening but also due to the possibility of modifying the glass band surface in this chamber with the aim of imparting prescribed the service and physicochemical properties to the glass.

The conditions of feeding the glass melt onto molted tin and its spreading over the tin melt are of special significance in the float-glass process, since these stages to a large extent determine the quality of the lower and upper surfaces of the glass band and its optical characteristics. The main reason for optical distortions in the glass band is the disturbance of the homogeneous laminated structure of the flow at the specified stages due to the variation of temperature and velocity regimes across the glass band width. The Institute is developing technological and design solutions making it possible to diminish the effect of the negative factors related to the glass melt discharge on the optical parameters of glass. For instance, a method has been developed for decreasing lateral spreading of the glass melt by means of using a wider chute, which makes it possible to reduce the lamination of the glass band, and, accordingly, the optical distortions (RF patent No. 2149838).

A number of research, design, and development studies has been carried out; as a consequence, a method for producing high-quality glass 8 – 12 mm thick, both clear and heat-absorbing and of various shades, has been developed. The latter is especially important since heat-absorbing glass enjoys a growing demand in the market. It should be noted that due to significant differences in properties (viscosity-temperature, IR spectrum absorption, etc.) between heat-absorbing and clear glass, special requirements are imposed on spreading and molding, since the alteration of the specified properties is mainly manifested in the high-temperature zone of the tank. The proposed method provides for the developments of such conditions, when a plane-parallel profile of a thickened band is formed in the discharge zone, and then the band spreading is controlled by the edge-restricting machines with special operating parameters (RF patent No. 2149838).

A substantial demand for sheet glass promotes the construction of new float-lines. The Saratov Institute of Glass specializes in research into float-glass technology, has practical experience in design and development, has participated in upgrading leading glass factories, and supervises operations of float-glass lines. Extensive statistical and research database has been accumulated, which makes it possible to design float tanks and determine their geometrical characteristics depending on the line efficiency and the scheduled glass product range. The Institute has as well some experience in applying mathematical modeling to designing melt tanks.

The Saratov Institute of Glass continues research in upgrading the float process and has a number of development solutions which make it possible to improve the glass quality, to increase the yield of acceptable glass, and to expand the product range, which is especially important for float-lines of a medium or a small capacity.